Abstracts from the 2012 Eastern Vascular Society Annual Meeting

The Comprehensive Risk Assessment for Bypass (CRAB): An Efficient Perioperative Risk Assessment Instrument for Patients With Critical Limb Ischemia

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Objective(s): Specific risk assessment models have been developed for bariatric and colorectal procedures. A similar instrument, specific for patients with critical limb ischemia (CLI), could improve patient-centered clinical decision making. We describe a novel tool to predict 30-day major morbidity and mortality (M&M) after bypass surgery for CLI.

Methods: The 2007-2009 National Surgical Quality Improvement Program patient data (N = 4894) were analyzed to test 32 preoperative factors for association with 30-day M&M. Significant predictors in multivariate models were assigned integer values (points), which were added to calculate a patient's comprehensive risk assessment for bypass (CRAB) score. Performance was assessed (C-index) and compared with other tools (American Society of Anesthesiologists class, Surgical Risk Scale, and Prevent III score) on a distinct validation sample of 1620 individuals.

Results: Overall, 921 patients (18.8%) suffered major morbidity and 144 (2.9%) died. The CRAB model included seven predictors of 30-day M&M (Table). Applied to the validation sample, the CRAB score accurately predicted morbidity and mortality rates: 14% and 1%, respectively, in low-risk patients (CRAB ≤2) vs 22% and 6% (CRAB 3-4) vs 31% and 15% in high-risk patients (CRAB ≥5; $P < .001$). Accuracy of CRAB mortality prediction (C-index = .76, $P < .001$) exceeded American Society of Anesthesiologists class (0.59), Surgical Risk Scale (0.6), and Prevent III score (0.65). CRAB was the only model to predict morbidity at a statistically significant level ($P < .01$).

Conclusions: The CRAB is the first targeted risk assessment instrument for morbidity and mortality after bypass surgery in CLI patients. The assessment uses clinically relevant factors and a straightforward scoring system, it is superior to other general models for prediction of mortality, and is the only instrument to predict major morbidity. This unique tool provides an evidence basis for patient-centered clinical decision-making, and may have a role at identifying patients at the highest risk for surgery in whom an endovascular approach is preferable.

Table. CRAB score

Variable	*Points*	*AOR (95% CI)*	P
Age >75 years	1	1.31 (1.09-1.59)	.004
Dialysis dependence	1	1.49 (1.14-1.93)	.003
Agnina within 6 months	1	1.54 (1.1-2.25)	.02
Prior extremity revascularization	1	1.42 (1.18-1.70)	<.001
Obesity	1	1.53 (1.26-1.86)	<.001
Emergency surgery	2	2.15 (1.42-3.25)	<.001
Functional dependence			
Partial	2	1.79 (1.47-2.19)	<.001
Total	3	2.37 (1.34-4.17)	.003
Total maximum points	10		

AOR, Adjusted odds ratio; *CI,* confidence interval.

Efficacy and Cost-Effectiveness of Endovascular vs Conventional Bypass Revascularization for Critical Limb Ischemia

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Objective(s): This study is a review and evaluation of two modalities of revascularization for patients with critical limb ischemia—endovascular (EV) and conventional bypass (CB) surgery—to identify efficacy and cost-effectiveness by comparing reintervention rate, amputation rate, and total cost to hospital in this particular group.

Methods: Retrospective review was performed for 214 cases in 192 patients with diagnosis of critical limb ischemia requiring revascularization between 2007 and 2011. We evaluated reintervention rate and amputation rate at 1, 3, 6, 12, and <36 months in primary EV vs CB surgery groups. The total cost to the hospital was also compared in these groups.

Results: Between July 2007 and June 2011, Conemaugh Physicians Group Vascular Surgery Department treated 214 limbs in 192 patients with diagnosis of critical limb ischemia. CB surgery using vein graft was performed in 84 limbs (39.3%), and EV primary revascularization, including atherectomy, balloon angioplasty, and stent placement, was performed in 130 limbs (60.7%). The cumulative amputation rate in both groups was 13.1% at 36 months, of which 8.8% (19 limbs) were in the EV group, and 4.2% (nine limbs) were in the CB group ($P = .671$). The amputation rate was 2.3%, 9.2%, 11.5%, 13%, and 14.5% in the EV group and 3.6%, 6%, 7.2%, 8.4%, 9.6%, and 10.8% in the CB group, respectively, at 1, 3, 6, 12, 24, and 36 months. The cumulative secondary intervention rate in both groups was 24% at 36 months. Of these, 12.6% were in the EV group and 11.7% were in the CB group ($P = .940$). Secondary intervention rates were 5.4%, 10.8%, 14.6%, 19.2%, 20.0%, 20.9% in the EV group and 8.3%, 15.5%, 21.4%, 27.4%, 28.6%, and 29.7% in the CB group at 1, 3, 6, 12, 24, and 36 months, respectively. During 36 months of follow-up, more than two interventions for limb salvage were required in 4.6% in the EV and in 8.3% in the CB group ($P = .268$). Total cost to the hospital for the first intervention was $27,365.03 ± $18,916.34 (range, $3,018-$119,518) in the EV group and $24,727.99 ±14,373.89 (range, $6,570-$70,282) in the CB groups ($P = .292$).

Conclusions: In our experience, EV revascularization is as effective for limb salvage and cost-effective as CB for the primary treatment of critical limb ischemia.

Subsequent Open Surgical Revascularization Following an Initial Endovascular Approach for Critical Limb Ischemia

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Objective(s): Endovascular treatment (endoRx) is often used as the initial treatment for critical limb ischemia. The goal of this study was to examine the likelihood, predictors, and outcomes of open surgical (OS) revascularization or reintervention after initial endoRx for critical limb ischemia.

Methods: We retrospectively reviewed a prospectively collected database from January 1, 2007, to December 31, 2010. Demographics, Rutherford classification, prior procedures, secondary endoRx, and limb salvage rates were analyzed. Statistical significance was determined by χ^2 and multivariate regression analysis with $P = .025$.

Results: Of the 302 study patients, 126 (41%) had initial OS; 158 (52%) had initial endoRx; and 21 (7%) had hybrid procedures. Of the 126 patients treated by initial OS, 57 (45%) required a secondary endoRx. Of the 158 patients who initially underwent endoRx, 71 (45%) required a secondary OS. Compared with those who were treated by initial OS, patients who had OS after failed endoRx had worse limb salvage rates (odds ratio, 1.6; 95% confidence interval, 0.215-0.894, $P = .023$). A similar outcome was seen in those who required repeat endoRx after a failed initial endoRx (odds ratio, 1.25; 95% confidence interval, 0.104-0.505, $P < .0001$). Diabetes and tissue loss predicted need for OS after initial endoRx. Only diabetes predicted the need for repeated endoRx after a failed initial attempt. Overall amputation rate was 14.9%. Renal failure and initial endoRx were predictors of major amputation when controlling for all potential confounders.

Conclusions: Patients who require open OS revascularization or repeated endoRx after initial endoRx for CLI have worse limb salvage rates than patients who undergo initial OS revascularization. Therefore, in select patients in whom an appropriate surgical option exists, OS revascularization should be considered as the initial therapy for critical limb ischemia.

Outcomes in the Elderly of Open and Endovascular Interventions for Advanced Superficial Femoral Artery Occlusive Disease

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Objective(s): The number of patients aged ≥80 years undergoing treatment of symptomatic advanced femoropopliteal disease is increasing. This study examined the clinical efficacy of these interventions in this specific population.

Methods: A database of patients undergoing open (OPEN) and endoluminal (ENDO) intervention for TransAtlantic Inter-Society Concensus (TASC) II C and D femoropopliteal lesions between 1990 and 2010 was retrospectively queried. Patients aged ≥80 years were selected. Kaplan-Meier survival analyses were performed to assess time-dependent outcomes. Factor analyses were performed using a Cox proportional hazard model for time dependent variables.

Results: During the 20-year period, 2539 patients underwent OPEN or ENDO treatment for symptomatic and anatomically advanced femoropopliteal disease (TASC II C and D); of these, 353 (14%) were aged ≥80 years (Table). There was a significant difference in the ages and modified cardiac risk index between the two groups, with older and more high risk patients undergoing ENDO. The groups had equivalent comorbidities and survival. OPEN was more commonly performed on those with rest pain/